Cohort Considerations
(May 29, 2010; rev. Apr. 24, 2011)

Format note: This is PDF version of the Cohort Considerations sub-page of the Measuring Health Disparities page of jpscanlan.com, with endnotes converted to footnotes.

Note added April 24, 2011: Some of the points made below based on hypothetical data are illustrated with actual life table information in a Life Table Information document.

This page, which is still a draft, treats an important issue related to the issue treated on the Truncation Issues sub-page of the Scanlan's Rule page of jpscanlan.com. The Truncation Issues sub-page treats the way certain standard patterns of correlations between measures of differences in outcome rates and the prevalence of an outcome rate may differ where the populations examined are truncated portions of larger populations, as well as the more important issue of the invalidity of the approach described on the Solutions sub-page of the Measuring Health Disparities page in situations where the populations examined are truncated portions of larger populations. One obvious situation implicating these issues involves examination of differences in control of hypertension among persons deemed to be hypertensive. Certainly there are many others. And, as discussed in the February 10, 2008 Comment on Werner, sometimes it is not clear whether one is examining truncated portions of larger populations or not. But the instant issue may have more far-reaching implications.

The Solutions approach is generally suitable when considering rates that reflect dichotomizations of pairs of normal distributions. And while the examination of things like differences in infant mortality or cancer mortality involves such situations (even when one might be examining mortality differences as of the first, fifth, or tenth year) some situations do not. Thus, for example, the approach would not be suitable for examining differences in cancer mortality during the period from the sixth to the tenth year.

The point can be illustrated in Table CC-A below, which is based on Table 1 of the 2006 British Society for Population Studies presentation.[1] The BSPS table showed the implications of serially lowering, or raising, a cutoff point on a test with regard to standard measures of differences between rates. It was based on a situation where the means of the advantaged group (AG) and the disadvantaged group (DG) differed by half a standard deviation. Thus, at each point the estimated effect size (EES) derived from the two fail rates would be .50.[2]

But consider the data from the following perspective. Assume that each point moving down the table represents a situation where everyone above the point has by now experienced the adverse

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[1] The data in the table underlie many illustrations of patterns by which standard measures of differences between outcome rates vary with overall prevalence, including, for example, Figure 4 of the 2009 Royal Statistical Society presentation (with the advantaged group's success rates as benchmarks) and Figure 4 of the 2008 International Conference on Health Policy Statistics presentation (with the advantage group's failure rates as benchmarks).

[2] While the fail rates are based on the .50 standard deviation difference between means, because of rounding, the fail rates shown will not invariably yield a .50 standard deviation difference. To avoid confusion, .50 is shown in the relevant columns of Tables CC-A and CC-B to this item.

outcome. One might think of it in terms deaths of an aging population. If at each point we derived an EES on the basis of the proportion of each group that had so far died, again, the EES would always be .50 (Overall EES) .

Typically, however, researchers do not examine mortality rates that way. Rather, they examine a group of deaths that had occurred during a particular time period among persons alive at the beginning of the period. Thus, at point 01 In Table CC-A (which can be analogized to Year 1) the mortality rate of AG would be 1.0% while the mortality rate of DG would be 3.44% and the EES would be .50. But at point N 3 (which can be analogized to year 2), when an additional 2.0% of the original AG cohort and an additional 4.94% of the DG original cohort died, typically researchers would not compare the 3.0% (1.0% plus 2.0%) of the AG cohort and the 8.38% (3.44% plus 4.94%) of the original DG cohort shown in the AGF and DGF columns of Table CC-A (and again find an EES of .5). Rather, they would derive mortality rates for that period using the numbers of deaths during the period as the numerators and the populations remaining at the beginning of the period as the denominators. In the case of the row N3, such figures would be 2.02% and 5.12%, and the EES (IntervalEES) derived from such figures would be .41 rather than .50. And, as similar operations are performed in subsequent years, we would observe a pattern whereby the EES declines even though all nothing has occurred other than the standard consequence of the EES at the start of the period.

Table CC-A – Comparison of EES Figures Derived from Overall Failure Rates at Each Point and Derived From Failure Rates Between Each Point (b0527 d 1)

Cut Point	AGF	DGF	IntAGF	IntDGF	OverallEES	Interval EES
O 1	1.00%	3.44%	1.00%	3.44%	0.5	0.5
N 3	3.00%	8.38%	2.02%	5.12%	0.5	0.41
M 5	5.00%	12.71%	2.06%	4.73%	0.5	0.38
L 10	10.00%	21.77%	5.26%	10.37%	0.5	0.37
K 20	20.00%	36.69%	11.11%	19.08%	0.5	0.36
J 30	30.00%	49.20%	12.50%	19.76%	0.5	0.31
I 40	40.00%	59.48%	14.29%	20.24%	0.5	0.23
H 50	50.00%	69.15%	16.67%	23.85%	0.5	0.26
G 60	60.00%	77.34%	20.00%	26.55%	0.5	0.23
F 70	70.00%	84.61%	25.00%	32.11%	0.5	0.22
E 80	80.00%	90.99%	33.33%	41.43%	0.5	0.22
D 90	90.00%	96.25%	50.00%	58.34%	0.5	0.23
C 95	95.00%	98.38%	50.00%	56.90%	0.5	0.19
B 97	97.00%	99.13%	40.00%	46.48%	0.5	0.17
A 99	99.00%	99.76%	66.67%	72.29%	0.5	0.17

Table CC-B, which is based on data from Rows K 20, I 40, G 60, and E 80 of BSPS 2006 Table 1, provides an illustration of the matter that is somewhat simpler than that in Table CC-a, but that also demonstrates the way that the EES patterns will vary depending on the time periods examined (or proportion of the populations dying during each times period). Here we assume that by the end of period 1, 20% of AG and a corresponding proportion of DG (as defined by the .5 EES) has died. During each of periods 2, 3, and 4, another 20% of the original AG cohort and the corresponding proportion of the DG cohort has died. Comparing the proportions of each population that had died by the end of each period, we would again derive an EES of .5. But the mortality rates during periods 2, 3, and 4 based on persons alive at the beginning of each period would yield EES figures of only .32, .29, and .27.   Note that there is no correspondence between the interval EES figures for the corresponding rows in the two tables. For the interval EES figures in the two tables are based on different numbers of death and different populations at the beginning of each period examined.

Table CC-B – Comparison of EES Figures Derived from Overall Failure Rates at Each Point and Derived From Failure Rates Between Each Point – Limited to K 20, I 40, G 60, and E 80 (b0527 a 4)

Cut Point	AGF	DGF	IntAGF	IntDGF	OverallEES	IntervalEES
K 20	20.00%	36.69%	20.00%	36.69%	0.5	0.51
I 40	40.00%	59.48%	25.00%	36.00%	0.5	0.32
G 60	60.00%	77.34%	33.33%	44.06%	0.5	0.29
E 80	80.00%	90.99%	50.00%	60.23%	0.5	0.27

A more complex version of this Table CC-A is available as Table CC-A Expanded. It shows the patterns of changes in (a) relative differences in the adverse outcome, (b) relative differences in the favorable outcome, (c) absolute differences between rates, (d) and odds ratios both as presented in BSPS Table 1 and as they would appear if each row were based on adverse outcomes among persons who had not yet experienced the outcome. Thus, it enables one to observe contrasts in such patterns dependent on the approach akin to those illustrated or discussed with regard to truncated portions of larger populations in the 2008 International Conference on Health Policy Statistics Presentation and the Truncation Issues sub-page of the Scanlan's Rule page. But such illustrations are useful solely for demonstrating variations in patterns of standard measures of differences between rates in circumstances where the patterns of underlying distributions are known not to be normal. Given that those measures are not useful for appraising the size of differences even when the distributions are normal, the illustrations are of limited importance. Here we are principally concerned with illustrating circumstances where a measure that is useful when the underlying distributions are normal may not be useful.

Now consider a scenario somewhat more complicated than those reflected in Tables CC-1 and CC-B. Table A of the Irreducible Minimums sub-page of the MHD explores the differences between black and white mortality rates (by gender) among various age groups. It treats that matter with respect to a perception – based on smaller relative differences in mortality among the old than among the young – that health disparities are greater at younger ages. For reasons discussed in many places, such pattern is a standard consequence of increasing mortality, and neither it – nor the patterns of age-related increasing relative differences in survival rates and absolute differences between mortality or survival rates – effectively indicate whether the disparities are increasing or decreasing in a meaningful sense. Nevertheless, Table A shows that the EES declines with age, thus suggesting that the mortality disparity decreases with age in a meaningful sense.

But Table A of the Irreducible Minimums sub-page (which I set out below) also explores whether that conclusion would hold if irreducible minimums were taken into account. I leave discussion of the table to the Irreducible Minimums sub-page. Here I instead address the implications of the factors described above with regard to Table 1 of the BSPS 2006 presentation but using data drawn from Table A of the Irreducible Minimums sub-page.

Table A (of Irreducible Minimums sub-page): Analysis of Mortality Differences between Blacks and Whites by Age and Gender, with and without Adjustment for Irreducible Minimums											
Gender	AgeGrp	WMR	BMR	IrrMinRate	WAdjMR	BAdjMR	MR	AdjMR	SR	EES	AdjEES
M	45-49	0.44%	1.08%	10.00%	0.40%	1.04%	2.45	2.62	1.006480	0.325	0.34
M	50-54	0.70%	1.59%	20.00%	0.56%	1.45%	2.29	2.61	1.009104	0.31	0.36
M	55-59	1.16%	2.26%	40.00%	0.70%	1.81%	1.95	2.58	1.011254	0.27	0.36
M	60-64	1.85%	3.19%	50.00%	0.93%	2.28%	1.73	2.45	1.013840	0.24	0.35
M	65-69	2.80%	4.49%	60.00%	1.14%	2.86%	1.61	2.52	1.017768	0.21	0.38
M	70-74	4.33%	6.04%	70.00%	1.34%	3.11%	1.40	2.32	1.018231	0.16	0.34
M	75-79	6.60%	8.18%	80.00%	1.39%	3.07%	1.24	2.20	1.017273	0.12	0.33
M	80-84	10.26%	10.98%	90.00%	1.13%	1.93%	1.07	1.71	1.008144	0.045	0.21
F	45-49	0.24%	0.52%	10.00%	0.21%	0.50%	2.20	2.33	1.002844	0.265	0.28
F	50-54	0.40%	0.79%	20.00%	0.32%	0.71%	1.97	2.21	1.003890	0.225	0.275
F	55-59	0.65%	1.18%	40.00%	0.39%	0.92%	1.81	2.35	1.005312	0.21	0.3
F	60-64	1.02%	1.80%	50.00%	0.51%	1.30%	1.77	2.54	1.007973	0.225	0.345
F	65-69	1.55%	2.52%	60.00%	0.63%	1.61%	1.63	2.57	1.009981	0.2	0.36
F	70-74	2.43%	3.48%	70.00%	0.74%	1.81%	1.43	2.45	1.010930	0.16	0.35
F	75-79	3.85%	5.07%	80.00%	0.79%	2.06%	1.32	2.59	1.012915	0.13	0.37
F	80-84	6.46%	7.33%	90.00%	0.69%	1.62%	1.14	2.36	1.009463	0.075	0.33
F	85-89	10.89%	11.01%	90.00%	1.21%	1.34%	1.01	1.11	1.001314	0.015	0.025

To simplify the matter, think in terms of populations of black and white men and women who are 45 years of age in the first year under examination. Think also that the white men and women in this cohort are reduced each year by the percent shown in Irreducible Minimum Table A as the yearly mortality rate for the next five years. And assume that blacks in the corresponding cohorts die at rates that would be observed if the EES calculated for the first year remained constant over the next decade.[3] In other words, the pattern of racial differences in mortality in that cohort is assumed not to change at all.

But, as discussed with regard to Tables CC-A and CC-B above, typically the mortality rates would not be examined in such manner – that is, in terms of the proportion of each cohort that had died as a particular point in time. Rather mortality rates would be calculated each year based on the population alive at the beginning of the year and the population that died during the year. Using the methodology underlying Tables CC-A and CC-B to this item, Table CC-C shows the pattern by which EES figures based on the yearly mortality rates decline even though the deaths observed were consistent with the original EES figures for the cohort.

[3] Since the database I employ to derive the EES figures (available on the Solutions Database sub-page of MHD) is limited to intervals of .01 standard deviations, I have rounded the male EES to .33 and the female EES to .27. One will note that in Table CC-C, the Year 1 figures, which there are derived from the Year 1 rates are .34 and .28. The difference may be due to rounding or there may be an error that I will eventually correct. But the discrepancy does not affect the discussion that follows.

Table CC-C: Comparison of EES Figures for Differences Between Black and White Mortality Rates by Gender Derived from Overall Mortality Rates at Various Cut Point with EES Figures Derived from Figures Between Cut Points (b0527 c 1)							
Gender	Year	%WhMortToDate	%BlackMortToDate	WhYearlyMR	BlYearlYMR	OverallEES	YearlyEES
M	1	0.44%	1.09%	0.44%	1.09%	0.34	0.34
M	2	0.88%	2.07%	0.44%	0.99%	0.34	0.31
M	3	1.32%	2.91%	0.44%	0.86%	0.34	0.25
M	4	1.76%	3.75%	0.45%	0.87%	0.34	0.25
M	5	2.20%	4.65%	0.45%	0.93%	0.34	0.28
M	6	2.64%	5.37%	0.45%	0.76%	0.34	0.21
M	7	3.08%	6.18%	0.45%	0.85%	0.34	0.24
M	8	3.52%	6.94%	0.45%	0.82%	0.34	0.21
M	9	3.96%	7.78%	0.46%	0.90%	0.34	0.24
M	10	4.40%	8.38%	0.46%	0.65%	0.34	0.13
F	1	0.24%	0.53%	0.24%	0.53%	0.28	0.28
F	2	0.48%	1.02%	0.24%	0.49%	0.28	0.25
F	3	0.72%	1.46%	0.24%	0.45%	0.28	0.22
F	4	0.96%	1.92%	0.24%	0.47%	0.28	0.23
F	5	1.20%	2.33%	0.24%	0.41%	0.28	0.19
F	6	1.44%	2.74%	0.24%	0.42%	0.28	0.19
F	7	1.68%	3.18%	0.24%	0.45%	0.28	0.22
F	8	1.92%	3.59%	0.24%	0.43%	0.28	0.19
F	9	2.16%	3.96%	0.24%	0.38%	0.28	0.16
F	10	2.40%	4.36%	0.25%	0.42%	0.28	0.19

There may be more realistic ways to model this pattern. And it should be borne in mind that a cohort of persons 45 years old at a particular point in time are in fact truncated portions of cohorts that might have been identified earlier. But I doubt that more realistic specifications will alter the general pattern observed in Table C-CC – that is, that EES figures will tend to decline as the cohort ages. And while patterns observed as a cohort ages only approximate patterns that would be observed among different age groups at a particular point in time, the patterns observed in Table C-CC suggest that a conclusion that mortality differences tend to decrease with age as might be derived from the basic EES figures in Table A of the Irreducible Minimums page is not justified.[4]

These considerations would seem also to apply to the illustrations in Tables 6 and 8 of the 2008 British Society for Population Studies presentation and Table 6 of the 2008 Nordic Demographic

[4] As discussed in the Irreducible Minimum page, whatever the factors underlying racial or socioeconomic differences in health, as to most health outcomes it would seem that the factors would have greater effect on persons who had been subjected to them for a longer period of time. It is true that, however one measures disparities, it would seem evident that racial differences in mortality due to violence are much greater at younger ages (ages in fact generally much lower than the age groups in Table A of the Irreducible Minimums page). But such fact raises different issues from those involved here. Of course, there may be other factors that would tend to cause disparities, properly measured, to be greater among the young than the old and have an effect with regard to persons in early middle age compared with the elderly.

Symposium (NDS) presentation.[5] But the considerations would not seem to apply to Table 1 of the Mortality and Survival page of jpscanlan.com. For there the older cohorts do not bear the same relationship to the younger cohorts as in the other tables just mentioned.

For ease of reference, the tables just mentioned are replicated below:

Table 6 (BSPS 2008) – Illustration of UK Differences Across Age Groups from Table 4.13 of *The Widening Gap*

Year	Cohort	Class_I	Class_V	Mort_Ratio	Survival_Ratio	AbsDf	EES
1991	25-34	39	187	4.8	1.001483	148	0.47
1991	35-44	101	382	3.8	1.002821	281	0.42
1991	45-54	306	916	3	1.006156	610	0.39
1991	55-64	953	2484	2.6	1.0157	1531	0.39

Table 8 (BSPS 2008) – Illustration of Age Group Comparisons in Whitehall Studies from Marang-van de Mheen (*JECH* 2001) (rates are epr 1,000)

Age	HGMR	LGMR	AbsDf	MortRatio	SurvRatio	EES
55-59	6.8	13.9	7.1	2.05	1.0072001	0.27
60-64	11.3	19.9	8.6	1.76	1.0087746	0.22
65-69	17.5	28.1	10.6	1.61	1.0109065	0.2
70-74	30.9	47.5	16.6	1.54	1.0174278	0.2
75-79	50.6	70	19.4	1.38	1.0208602	0.16
80-84	78.3	107.6	29.3	1.38	1.0328328	0.19
85-89	144.3	181.6	37.3	1.26	1.0455767	0.16

Table 6 (NDS 2008) Illustration from Laaksonen et al. (*JECH* 2008) Based on Mortality Rates of Finnish Men by Owner or Renter Status

Age	OwnMort	RentMort	AdvRatio	FavRatio	EES
40–44	1.46%	4.26%	2.91	1.03	0.46
45–49	2.46%	6.04%	2.45	1.04	0.42
50–54	3.68%	9.68%	2.63	1.07	0.49
55–59	5.62%	13.09%	2.33	1.09	0.47
60–64	8.88%	19.89%	2.24	1.14	0.5
65–69	14.33%	29.38%	2.05	1.21	0.53
70–74	24.62%	41.85%	1.7	1.3	0.48
75–79	36.55%	57.75%	1.58	1.5	0.56

[5] In Table 6 of the NDS presentation, the NDS does not decline with age. That could suggest that in a meaningful sense mortality inequalities increase with age.

Table 1(of Mortality and Survival Page): Five-year survival and mortality ratios by age group (based on Morse et al.)

Gen	Category	WSurv	BSurv	WMort	BMort	W/BSurvRatio	B/WMortRatio	EES
M	< 45	76.70%	51.10%	23.30%	48.90%	1.50	2.10	0.72
M	45-54	66.10%	34.10%	33.90%	65.90%	1.94	1.94	0.85
M	55-64	59.10%	30.80%	40.90%	69.20%	1.92	1.69	0.75
M	65-74	56.30%	29.70%	43.70%	70.30%	1.90	1.61	0.71
M	≥ 75	50.50%	17.10%	49.50%	82.90%	2.95	1.67	0.99
F	< 45	86.30%	70.50%	13.70%	29.50%	1.22	2.15	0.56
F	45-54	73.20%	50.50%	26.80%	49.50%	1.45	1.85	0.62
F	55-64	66.10%	48.30%	33.90%	51.70%	1.37	1.53	0.48
F	65-74	57.20%	37.80%	42.80%	62.20%	1.51	1.45	0.51
F	≥ 75	45.70%	42.80%	54.30%	57.20%	1.07	1.05	0.08